

(4) Cross Section

Provide the minimum ramp widths given in [Exhibit 1360-6](#). Ramp traveled ways may need additional width to these minimums as one-way turning roadways. (See Chapters [1230](#) and [1240](#) for additional information and roadway sections.)

Cross slope and superelevation criteria for ramp traveled ways and shoulders are as given in Chapters [1230](#) and [1240](#) for roadways. At ramp terminals, the intersection lane and shoulder width design guidance shown in [Chapter 1310](#) may be used.

Whenever feasible, make the ramp cross slope at the ramp beginning or ending station equal to the cross slope of the through lane pavement. Where space is limited and superelevation runoff is long, or when parallel connections are used, the superelevation transition may be ended beyond (for on-ramps) or begun in advance of (for off-ramps) the ramp beginning or ending station, provided that the algebraic difference in cross slope at the edge of the through lane and the cross slope of the ramp does not exceed 4%. In such cases, provide smooth transitions for the edge of traveled way.

Number of Lanes			1	2
Ramp Width (ft)	Traveled Way ^[1]		15 ^[2]	25 ^[3]
	Shoulders	Right	8	8
		Left	2	4
	Medians ^[4]		6	8

Notes:

[1] For turning roadway widths, see [Chapter 1240](#), and for additional width when an HOV lane is present, see [Chapter 1410](#).

[2] May be reduced to 12 ft on tangents.

[3] Add 12 ft for each additional lane.

[4] The minimum two-way ramp median width (including shoulders) is given. Wider medians may be required for signs or other traffic control devices and their respective clearances. When either the on- or off-ramp is single-lane, use the one-lane column. If both directions are two lanes, use the two-lane column.

Ramp Widths

Exhibit 1360-6

Ramp shoulders may be used by large trucks for offtracking and by smaller vehicles cutting to the inside of curves. To accommodate this increased use, pave shoulders full depth.

(5) Two-Way Ramps

Two-way ramps are on- and off-ramps on a single roadway. Design two-way ramps as separate one-way ramps. Provide a raised median to physically separate the on- and off-ramps. Wider medians than given in [Exhibit 1360-6](#) may be required for signing or other traffic control devices and their clearances. (For signs, it is sign width plus 4 feet.) Where wider medians are required, provide a 2-foot clearance between the face of curb and the edge of traveled way. Where additional width is not required, the raised median width may be reduced to a double-faced mountable or extruded curb. Traffic barrier or a depressed median may be provided in place of the raised median.

Turn-Lane Cross-Slope Rollover

The design control at the crossover line (not to be confused with the crown line normally provided at the centerline of a roadway) is the algebraic difference in cross slope rates of the two adjacent lanes. Where both roadways slope down and away from the crossover crown line, the algebraic difference is the sum of their cross slope rates; where they slope in the same direction, it is the difference of their cross slope rates. A desirable maximum algebraic difference at a crossover crown line is 4 or 5 percent, but it may be as high as 8 percent at low speeds and where there are few trucks. The suggested maximum differences in cross slope rates at a crown line, related to the speed of turning traffic, are given in Exhibit 9-49.

Metric		US Customary	
Design speed of exit or entrance curve (km/h)	Maximum algebraic difference in cross slope at crossover line (%)	Design speed of exit or entrance curve (mph)	Maximum algebraic difference in cross slope at crossover line (%)
30 and under	5.0 to 8.0	20 and under	5.0 to 8.0
40 and 50	5.0 to 6.0	25 and 30	5.0 to 6.0
60 and over	4.0 to 5.0	35 and over	4.0 to 5.0

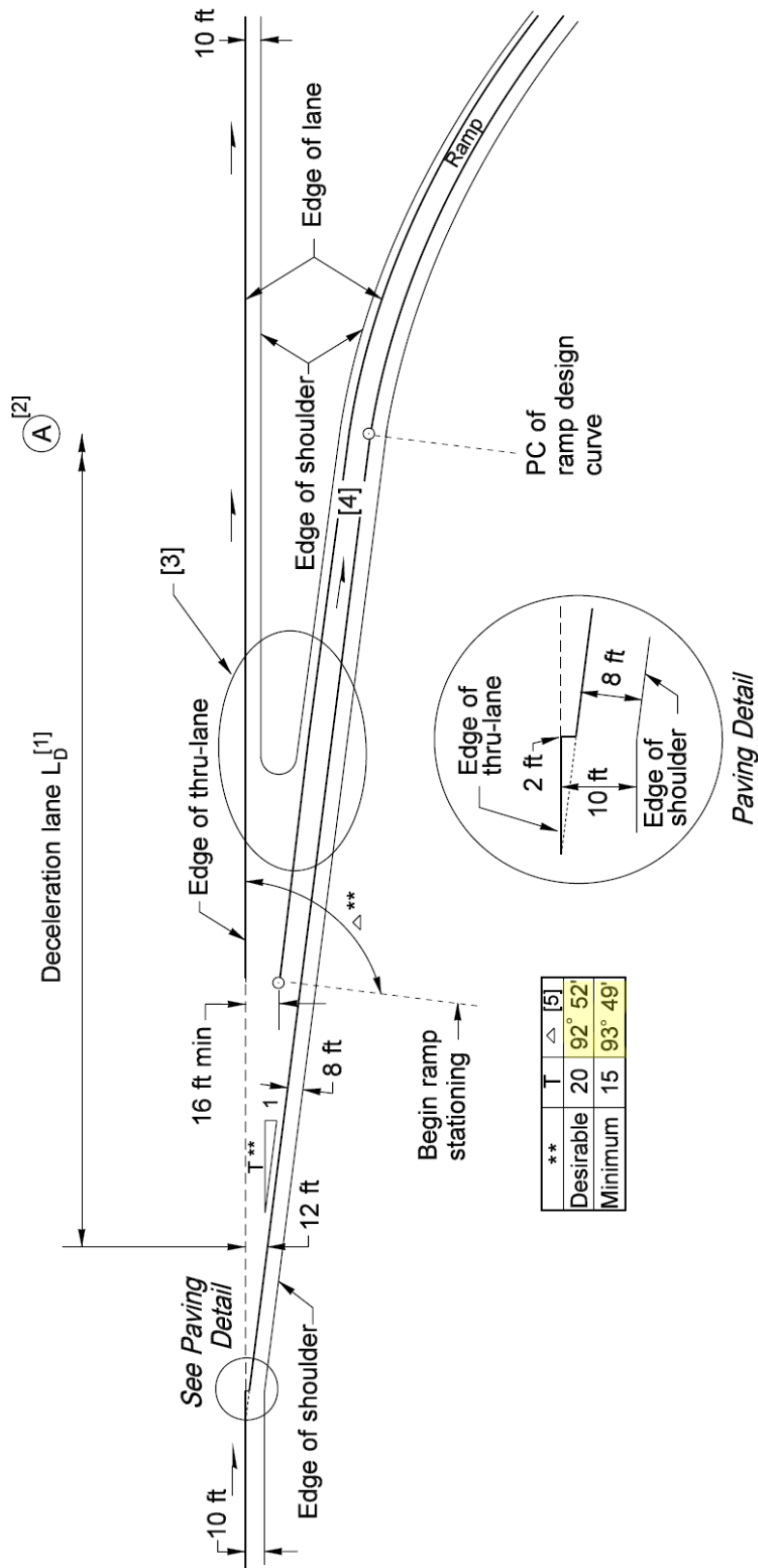
Exhibit 9-49. Maximum Algebraic Difference in Cross Slope at Turning Roadway Terminals

Superelevation Transition and Gradeline Control

The attainment of superelevation over the gradually widening auxiliary lane and over the whole of the turning roadway terminals should not be abrupt. The design should be in keeping with the cross-slope controls, given in Exhibit 9-49.

As an example, consider an arrangement as in Exhibit 9-45, in which the limiting curve of the turning roadway has a radius of 70 m [230 ft], corresponding to a design speed of 50 km/h [30 mph]. From Exhibit 3-34, the limiting superelevation rate would be 11 percent or less. Because the roadway width is variable, the transition of cross-slope change should be developed by using the method of traveled way edge change in grade with respect to the point of rotation for a full-width auxiliary lane. Elevations developed by this method should then be converted to a change in elevation between the edge of the traveled way of the through lane and the edge of the full-width pavement of the auxiliary lane. They then should be prorated for the actual partial widths of the auxiliary lane. In this example, the traveled way edge change in grade should be no greater than 0.65 percent [0.66 percent].

An alternate method, which has been noted with respect to rideability, comfort, and appearance of the roadway in cross-slope transition areas, is to establish a rate of change in the roadway cross slope. The rate of cross slope is a function of traveled way width and the change in grade of the edge of traveled way with respect to the point of roadway rotation. This method results in the edge grade being equal to the roadway width, which is rotated, times the rate of change in cross slope. Thus, if the edge of traveled way grade change is 0.65 percent



Off-Connection: Single-Lane, Tapered
Exhibit 1360-14a

Notes:

- [1] For deceleration lane length L_D , see [Exhibit 1360-10](#).
- [2] Point [A](#) is the point controlling the ramp design speed.
- [3] For gore details, see [Exhibit 1360-11a](#).
- [4] For ramp lane and shoulder widths, see [Exhibit 1360-6](#).
- [5] Approximate angle to establish ramp alignment.

General:

For striping, see the *Standard Plans*.

The operational and safety benefits of long acceleration lanes provided by parallel type entrances are well recognized. A long acceleration lane provides more time for the merging vehicles to find an opening in the through-traffic stream. An acceleration lane length of at least 360 m [1,200 ft], plus the taper, is desirable wherever it is anticipated that the ramp and freeway will frequently carry traffic volumes approximately equal to the design capacity of the merging area.

Single-Lane Free-Flow Terminals, Exits

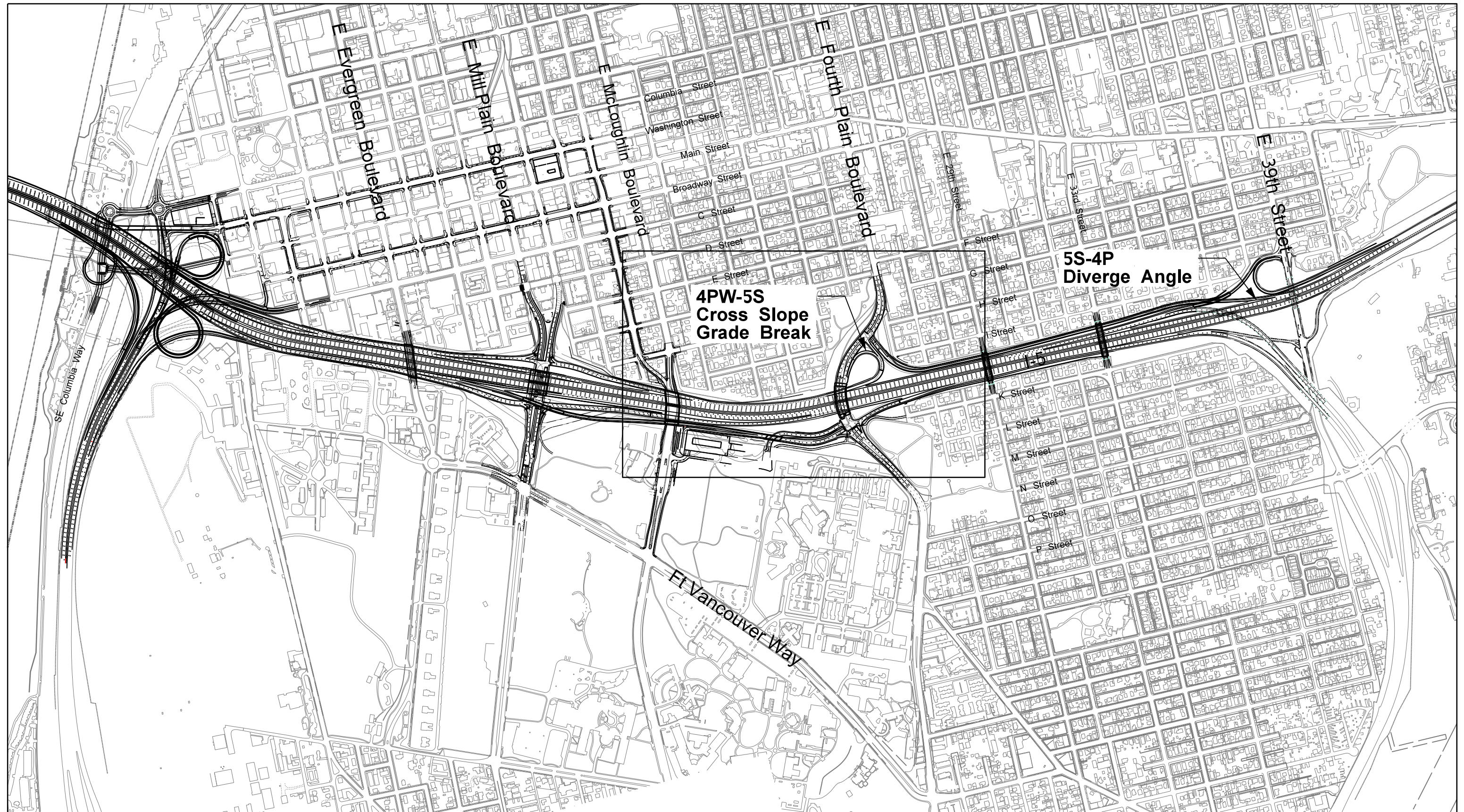
Taper-type exits. The taper-type exit fits the direct path preferred by most drivers, permitting them to follow an easy path within the diverging area. The taper-type exit terminal beginning with an outer edge alignment break usually provides a clear indication of the point of departure from the through lane and has generally been found to operate smoothly on high-volume freeways. The divergence angle is usually between 2 and 5 degrees.

Studies of this type of terminal show that most vehicles leave the through lane at relatively high speeds, thereby reducing the potential for rear-end collisions as a result of deceleration on the through lane. The speed change can be achieved off the traveled way as the exiting vehicle moves along the taper onto the ramp proper. Exhibit 10-72A shows a typical design for a taper-type exit.

Vehicles should decelerate after clearing the through-traffic lane and before reaching the point limiting design speed for the ramp proper. The length available for deceleration may be assumed to extend from a point where the right edge of the tapered wedge is about 3.6 m [12 ft] from the right edge of the right through lane, to the point of initial curvature of the exit ramp (i.e., the first horizontal curve on the ramp). The length provided between these points should be at least as great as the distance needed to accomplish the appropriate deceleration, which is governed by the speed of traffic on the through lane and the speed to be attained on the ramp. Deceleration may end in a complete stop, as at a crossroad terminal for a diamond interchange, or the critical speed may be governed by the curvature of the ramp roadway. Minimum deceleration lengths for various combinations of design speeds for the highway and for the ramp roadway are given in Exhibit 10-73. Grade adjustments are given in Exhibit 10-71.

The taper-type exit terminal design can be used advantageously in developing the desired long, narrow, triangular emergency maneuver area just upstream from the exit nose located at a proper offset from both the through lane and separate ramp lane. The taper configuration also works well in the length-width superelevation adjustments to obtain a ramp cross slope different from that of the through lane.

The width of the recovery area or the distance between the inner edges of the diverging lanes at the ramp nose is usually 6.0 to 9.0 m [20 to 30 ft]. This entire area should be paved to provide a maneuver and recovery area, but the desired travel path for the ramp roadway should be clearly delineated by pavement markings.



FOURTH PLAIN INTERCHANGE
VICINITY MAP

0 400 800
SCALE IN FEET

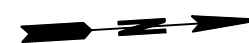


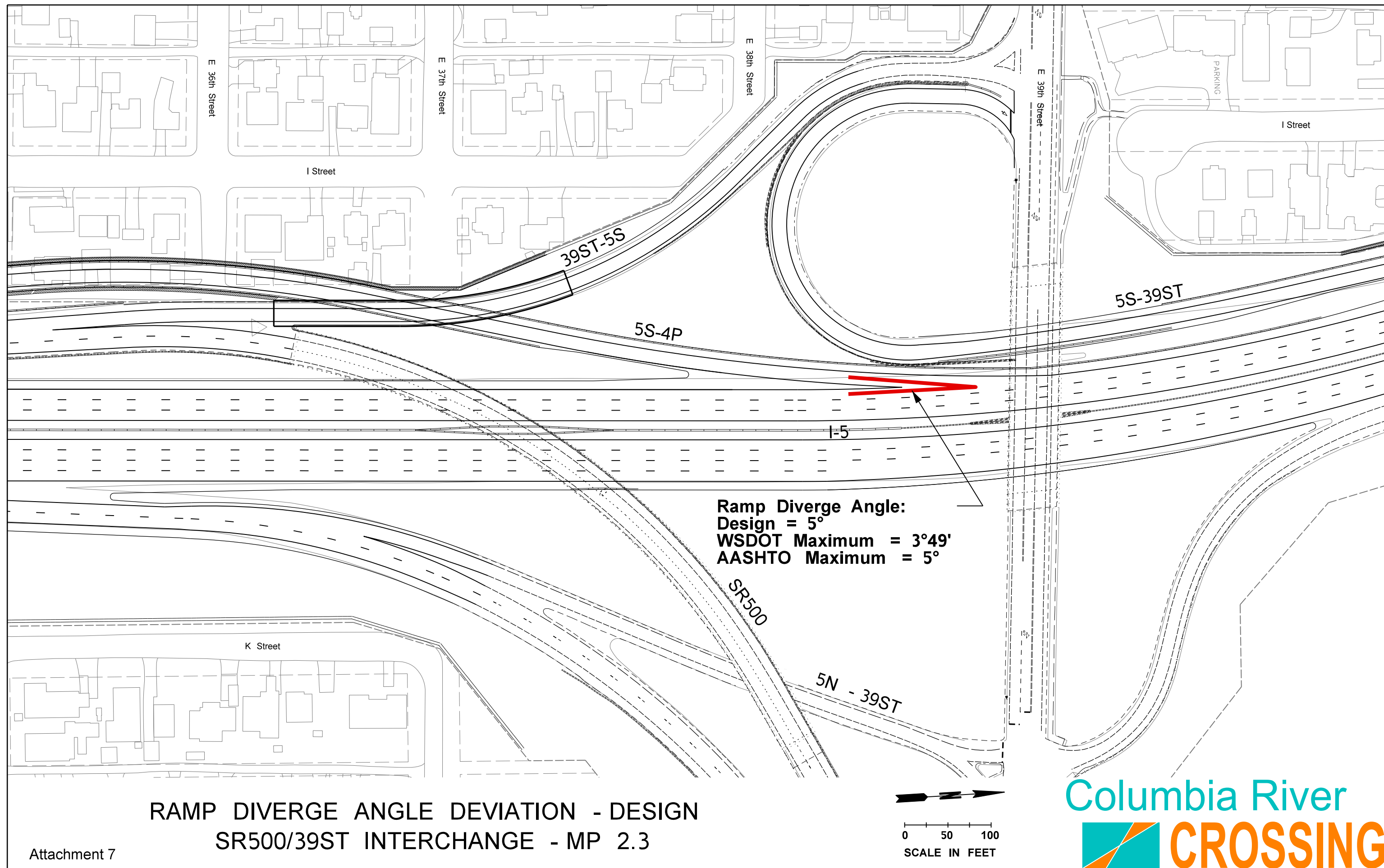


CROSS SLOPE GRADE BREAK DEVIATION - DESIGN
 FOURTH PLAIN INTERCHANGE - MP 1.58

Attachment 6

0 50 100
 SCALE IN FEET





RAMP DIVERGE ANGLE DEVIATION - DESIGN
SR500/39ST INTERCHANGE - MP 2.3